# WATER USE IN WISCONSIN, 1985

by B.R. Ellefson, Kraig S. Rury, James T. Krohelski

#### INTRODUCTION

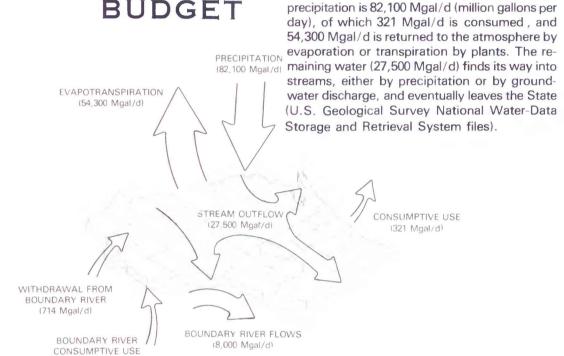
An inventory of water use in Wisconsin is essential for appraising current and future water-resource needs of the State. The U.S. Geological Survey has collected and published national water-use data every 5 years since 1950. Sources of data in these reports have not always been well documented, and the methods for collecting and reporting the data were not the same for all States. Some planning and management needs of the State are not met by water-use information that is available only every fifth year.

The U.S. Geological Survey entered into a cooperative program with the Wisconsin Department of Natural Resources (WDNR) in 1978. The purpose of the program was to collect and compile reliable annual water-use data and to develop computerized water-use data systems at the State and national levels. Data in standardized format for different categories of water use are available in the State Water Use Data System. The data base is updated annually or when more current water-use information is available. Information about amounts of water withdrawn, source of water, how the water was used, and how much water was returned is available to those involved in establishing water-resource policy and to those managing water resources. The data contained in this report are a summary of the 1985 data-collection effort.

#### DATA COLLECTION

Water-use data in Wisconsin are generally reported by major users to State agencies as part of State permit requirements. The WDNR collects water-use data for public supply, industrial, irrigation, sewage treatment, and some data on the amount of water used for power generation. The Wisconsin Public Service Commission collects information on how the public-supply water is used. Data in this report were obtained from these agencies. Estimates were made by the Survey based on population and average consumptive-use rates for water-use categories for which no data were reported.

#### WATER BUDGET

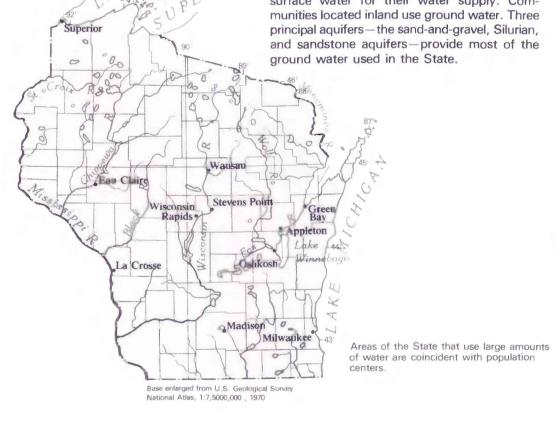


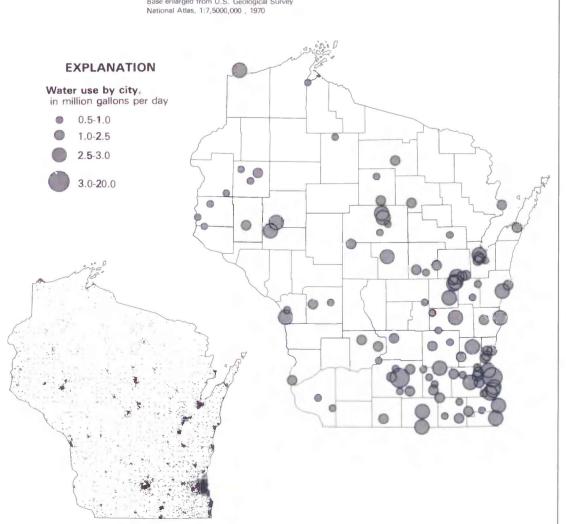
### SOURCES OF WATER

Wisconsin has an abundant supply of water. Surface water is found in 33,000 mi (miles) of streams and 15,000 lakes (U.S. Geological Survey, 1985b). About two quadrillion (2 × 10<sup>15</sup>) gallons, or about 1/3 the volume of Lake Superior, is stored in the State as ground water.

The water resources of Wisconsin are renewed continuously. Long-term average

Communities located on the shores of the Great Lakes and Lake Winnebago generally use surface water for their water supply. Communities located inland use ground water. Three principal aquifers—the sand-and-gravel, Silurian, and sandstone aguifers-provide most of the ground water used in the State.





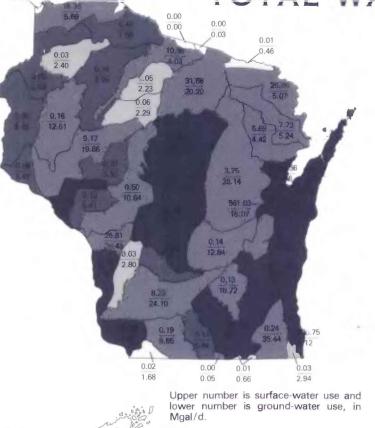
Each dot represents 1,000 people

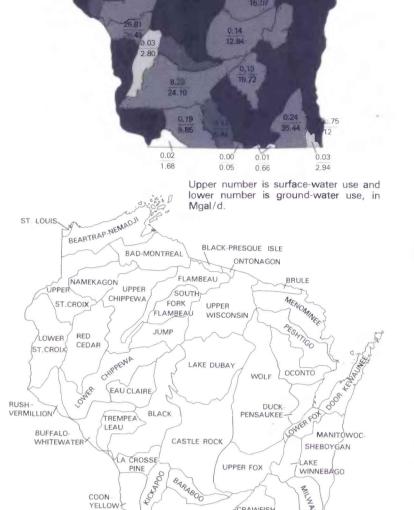
within a census tract, 1985.

# TOTAL WATER USE, BY BASIN

The largest industrial use occurred in the Lower Fox basin and was 173 Mgal/d; most of this was

surface water used by paper mills.

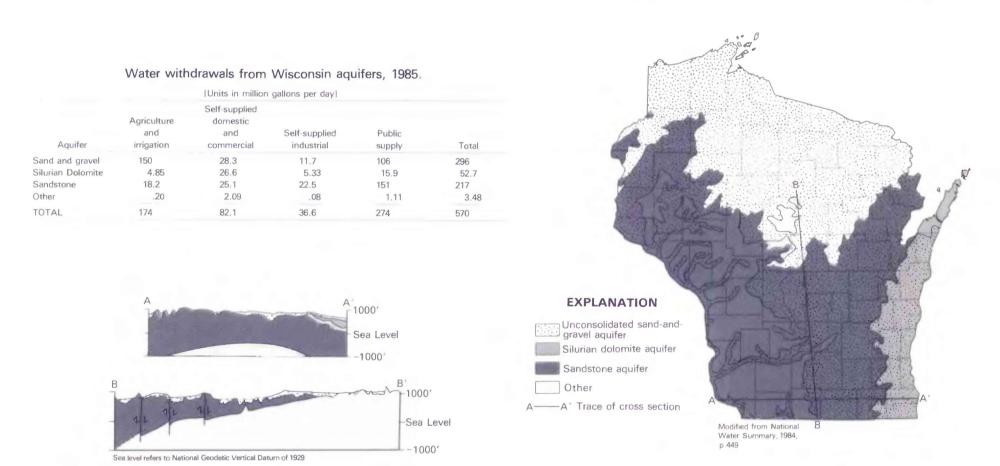




LOWER ROCK

Basin	Hydrologic						Thermo		
name	unit code	Domestic	Agriculture	Irrigation	Industrial	Commercial	electric	Other	Total
St. Louis	04010201	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.0
Beartrap-Nemadji	04010301	1.47	. 95	.00	6.21	.82	13.20	1.39	24.0
Bad-Montreal	04010301	.57	.73	.00	4.40	. 35	.00	.45	6.5
Black-Presque Isle	04020101	.06	.00	.01	.00	.00	.00	.00	. 0
Ontonagon	04020102	.03	.00	.00	.00	.00	.00	.00	. 0
Manitowoc-Sheboygan	04030101	9.57	3.60	.23	18.01	2.88	1,680.05	4.77	1.722.6
Ooor-Kewaunee	04030102	1.62	1.34	. 68	.71	. 39	506.01	. 89	511.6
Ouck-Pensaukee	04030103	. 99	. 89	.45	.07	. 15	.00	. 24	2.7
Oconto	04030104	1.52	1.80	. 46	5.94	. 18	. 00	.21	10.1
Peshtigo	04030105	1.50	1.96	. 07	9.05	. 14	.00	. 25	12.9
Brule	04030106	. 17	. 23	. 02	.00	. 02	.00	.03	. 4
fenominee	04030108	2.16	2.24	.05	26.11	. 27	.00	. 29	31.1
Jpper Fox	04030201	2.37	2.69	3.66	2.20	. 65	.00	1.41	12.9
Nolf	04030202	9.11	6.09	5.67	8.37	3.30	.00	. 64	33.1
Lake Winnebago	04030203	7.12	.89	.05	8.75	2.29	.00	7.92	27.0
Lower Fox	04030204	12.41	. 67	.03	173.26	6.52	377.40	6.81	577.1
Pike-Root	04040002	16.54	. 30	. 11	27.41	6.28	1,751.00	7.23	1,808.8
Milwaukee	04040003	56.95	.77	. 49	62.10	36.14	34.21	68.60	259.2
Jpper St. Croix	07030001	1.48	1.29	.04	. 05	.08	. 00	. 14	3.0
Namekagon	07030002	1.05	. 89	.10	.03	. 18	.00	. 18	2.4
ower St. Croix	07030005	2.94	1.40	. 45	1.51	1.00	. 00	1.23	8.5
Rush-Vermillion	07040001	1.34	1.36	. 08	. 39	. 14	.00	. 19	3.5
Buffalo-Whitewater	07040003	2.09	1.93	. 94	. 65	. 29	361.62	. 58	368.1
rempealeau	07040005	1.92	1.93	. 15	1.13	. 13	.00	. 28	5.5
La Crosse-Pine	07040006	6.20	1.94	. 22	8.66	4.03	26.70	5.48	53.2
Black	07040007	4.30	4.18	. 55	.51	. 24	.00	1.36	11.1
Upper Chippewa	07050001	1.70	2.08	. 20	.01	.04	.02	. 08	4.1
Flambeau South Fork Flambeau	07050002 07050003	.69	1.25	. 74	10.49	. 05	.00	. 52	2.2
Jump	07050004	.77	. 94	. 55	. 02	.01	.00	.06	2.3
Lower Chippewa	0705 <b>0</b> 005	5.43	2.18	1.30	14.95	2.20	.00	2.82	28.8
au Claire	07050006	1.28	.94	.56	. 27	.19	.00	. 34	3.5
Red Cedar	07050007	3.10	2.19	2.37	2.02	1.39	.00	1.70	12.7
Coon-Yellow	07060001	1.43	2.19	. 05	. 93	.40	136.44	. 59	142.0
Grant-Little Maquoketa	07060003	1.77	2.51	.00	.54	.36	190.19	. 67	196.0
Apple-Plum	07060005	. 59	. 76	.00	.02	.14	.00	. 19	1.7
Jpper Wisconsin	07070001	4.09	2.93	10.60	32.25	.71	. 00	1.32	51.9
Lake Dubay	07070002	8.66	3.60	16.60	36.51	2.55	112.00	.04	179.9
Castle Rock	07070003	8.84	4.56	16.60	112.98	3.07	12.66	2.77	161.4
Baraboo	07070004	2.11	. 97	3.50	1.37	.51	.00	. 58	9.0
ower Wisconsin	07070005	5.31	3.26	11.50	1.94	. 62	8.05	1.59	32.2
(ickapoo	07070006	1.33	.97	.00	. 06	.06	.00	.41	2.8
lpper Rock	07090001	27.81	8.24	2.18	24.50	17.67	234.16	24.20	338.7
rawfish	07090002	2.94	2.23	. 54	2.59	.91	. 00	1.64	10.8
Pecatonica	07090003	2.94	3.33	.83	.83	.72	.00	1.41	10.0
Sugar	07090004	1.90	1.92	.47	.32	. 31	.00	. 65	5.5
ower Rock	07090005	. 02	.03	.00	.00	.00	.00	.00	. 0
Cishwaukee	07090006	. 23	. 16	.00	. 18	. 05	.00	. 05	. 6
Des Plaines	07120004	2.36	. 19	.08	. 18	.07	. 00	.09	2.9
Jpper Fox	07120006	21.38	1.22	.40	5.64	3.08	.00	4.00	35.7

### TOTAL WATER USE BY AQUIFER



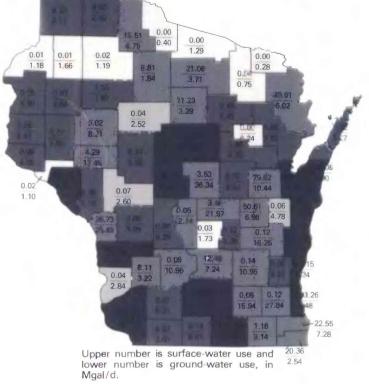
The sand-and-gravel aquifer is not continuous but is composed of numerous layers, lenses, terraces, and valley fillings of permeable sand and gravel. The sand-and-gravel aquifer overlies much of the State. Well yields from this aguifer are variable and depend on both the permeability and thickness of the sand and gravel.

The Silurian Dolomite aquifer is present only along Wisconsin's eastern shore. Silurian Dolomite is the uppermost rock unit in this area. Yields from this aquifer depend on the number of fractures and solution openings intersected by wells. The Silurian aquifer is underlain entirely by the sandstone aquifer.

The sandstone aquifer is present in the southern two-thirds of the State and is largely sandstone but includes beds of dolomite and siltstone. From north-central Wisconsin, the sandstone aguifer thickens to the east, south, and west. Where the aquifer is thick, it can yield large quantities of water. The sandstone aquifer is underlain by Precambrian

Other aquifers that do not produce as much water as the aguifers described above are present in Wisconsin. The most important of these is the Precambrian aquifer, which includes all rocks of Precambrian age that underlie Wisconsin. These rocks are crystalline and yield small quantities of water through fractures. The aquifer is used mostly for domestic purposes where the other aquifers are absent. A series of very thick Precambrian sandstones can yield large quantities of water in northwestern Wisconsin.

## TOTAL WATER USE, BY COUNTY



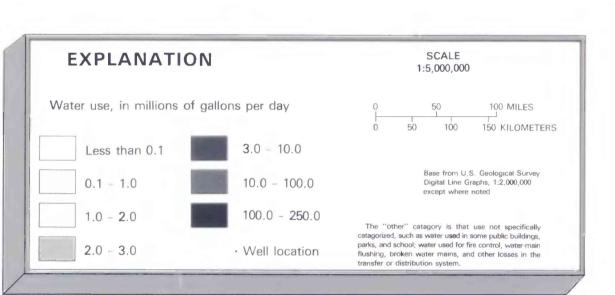
The greatest amounts of water were used in Manitowoc and Milwaukee Counties. Several large thermoelectric powerplants



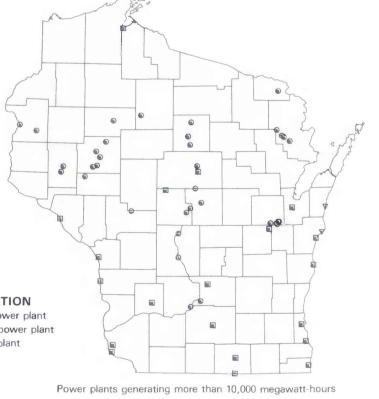
# Douglas 4.19 1.42 199.14 Jackson 2.02 26.83 4.88 52.20 Lafayette Langlade 4.25 1,010.00 .46 1,030.00 Marquette Milwaukee 33.38 1,777.00 68.70 1,999.74 Outagamie 379.49 2.39 Washington Waupaca 2.83 103.61

Table 1.— Water use, by county, 1985

Domestic Agriculture Irrigation Industrial Commercial Thermo Other Total



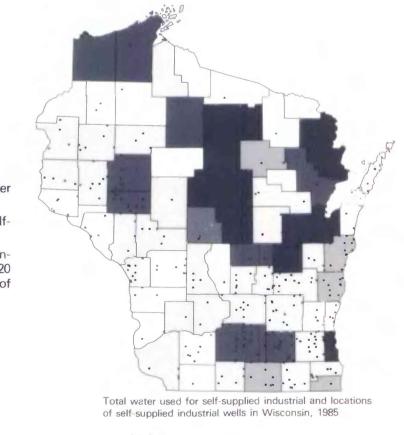
#### INTERIOR-GEOLOGICAL SURVEY, RESTON, VIRGINIA-1988



#### SELF-SUPPLIED INDUSTRIAL

About 614 Mgal/d of surface and ground water was used for industrial purposes. About 460 Mgal/d, or 75 percent, was self-

Consumptive-use rates differ widely among industry types but were estimated to be about 20 percent of ground water and 10 percent of surface-water withdrawals.



# SELECTED REFERENCES

Geological Survey Open-File Report 75-426.

Estimated use of water for irrigation in Wisconsin, 1984: U.S. Geological Survey Water-Resources Investigations Report 86-4079, 12 p. awrence, C. L., and Ellefson, B. R., 1982, Water use in Wisconsin, 1979: U.S. Geological Survey Water-

Resources Investigations Report 82-444, 98 p. 1984, Public-supply pumpage in Wisconsin, by 83-4931, 40 p.

United States-1950: U.S. Geological Survey Cir-

cular 115, 13 p.

McKichen, K. A., and Kammerer, J. C., 1961, Estimated use of water in the United States, 1960: U.S. Geological Survey Circular 456, 26 p.

Hutchinson, N. E., 1975, WATSTORE user's guide: U.S. Murray, C. R., and Reeves, E. B., 1977, Estimated use of water in the United States in 1975: U.S. Geological Survey Circular 765, 39 p.

Seaber, P. R., Kapinos, F. P., and Knapp, G. L., 1984, State hydrologic unit maps: U.S. Geological Survey Open-File Report 84-708, 198 p.

Solley, W. B., Chase, E. B., and Mann, W. B., IV, 1983, Estimated use of water in the United States in 1980: U.S. Geological Survey Circular 1001, 56 p.

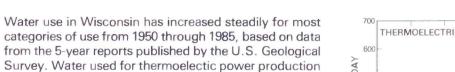
Solley, W. B., and others, Estimated use of water in the United States in 1985: U.S. Geological Survey Circular 1004 [in press]. U.S. Bureau of the Census, 1985, Census of the popula-

tion, characteristics of the population, number of

inhabitants - 1985. U.S. Geological Survey, 1985, National water summary, 1984-Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

U.S. Geological Survey, 1986a, National water summary, 1984 – Hydrologic events, selected water-quality trends, and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, 506 p.

events and surface-water resources: U.S. Geological



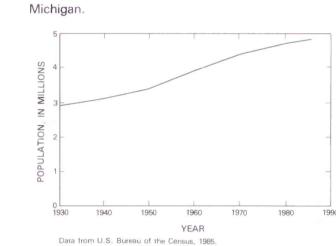
TRENDS IN WATER USE

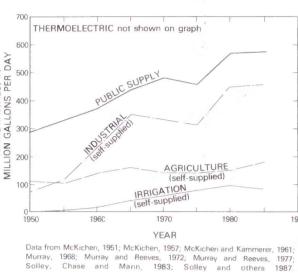
this period, the population of the State increased by 22 percent. Industrial self-supplied surface-water use also has increased at a steady rate as more industrial development has occurred on the Wisconsin, Fox, and Chippewa Rivers. Irrigation increased by 72 percent from 1974 through 1983; this increase is attributable to a drought

shows the fastest rate of increase (88 percent). During

In Dane County, which depends on ground water for its source, withdrawal rates have increased at a much higher rate than population growth.

Milwaukee County uses Lake Michigan as its principal source of water. The decline of ground-water pumpage from 1950 through 1985 in Milwaukee County is attributed to higher water cost for some publicly supplied ground water and the increased use of surface water from Lake





Wisconsin Department of Natural Resources

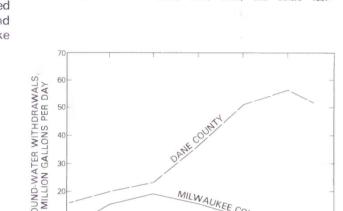
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 87-699

Department of the Interior U.S. Geological Survey

Prepared by

in cooperation with

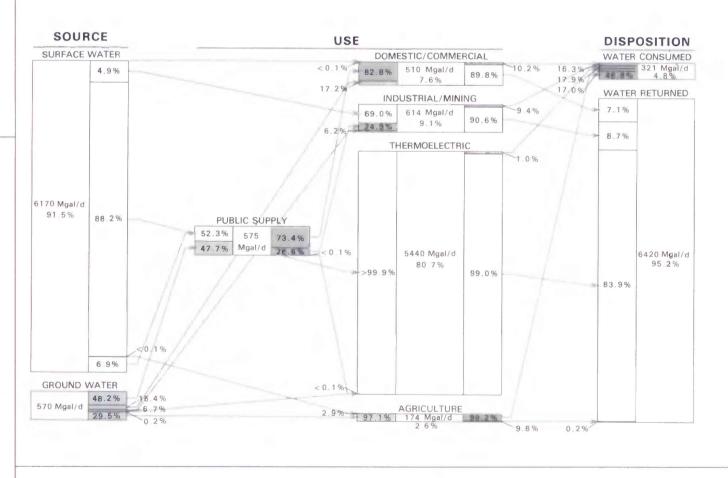


Data from A.J. Mackenzie, Northern Midwest RASA, written commun., 1987

# WATER SOURCES, USES, AND DISPOSITION

The figure shows the sources, uses, and disposition domestic/commercial and industrial). The "Disposition" of the State's water. For example, the "Source" column indicates that 4.8 percent of all water used was indicates that 570 Mgal/d of ground water was consumed and that 95.2 percent was returned. Of the withdrawn during 1985. Under the "Use" column, ground 4.8 percent that was consumed, 16.3 percent was for water was used in the various use categories as follows: domestic/commercial use, 17.9 percent was for in-15.4 percent was for domestic/commercial use, 6.7 perdustrial/mining use, 17.0 percent was for thermoelectric agricultural use, and 48.2 percent was for public supply use. (which is distributed by water utilities between

cent was for industrial use, 29.5 percent was for power generation, and 48.8 percent was for agricultural





Krohelski, J. T., Ellefson, B. R., and Storlie, C. A., 1986,

aquifer: U.S. Geological Survey Open-File Report

McKichen, K. A., 1951, Estimated use of water in the

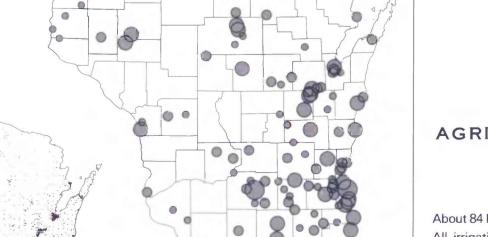
McKichen, K. A., 1957, Estimated use of water in the United States, 1955: U.S. Geological Survey Circular

Murray, C. R., 1968, Estimated use of water in the United States, 1965: U.S. Geological Survey Circular 556,

Murray, C. R., and Reeves, E. B., 1972, Estimated use of water in the United States in 1970: U.S. Geological Survey Circular 676, 37 p.

1986b, National water summary, 1985—Hydrologic

Survey Water-Supply Paper 2300, 506 p.



# AGRICULTURAL

PUBLIC SUPPLY Public supply refers to water withdrawn by public or private suppliers and delivered to

do not supply their own water.

supply ground water (42 Mgal/d).

domestic, commercial, and industrial users who

Public supplies served about 3.13 million people

Milwaukee County is the State's largest user of

Dane County is the State's largest user of public-

Other 26.8%

Total water use from public supply

public-supply surface water (198 Mgal/d).

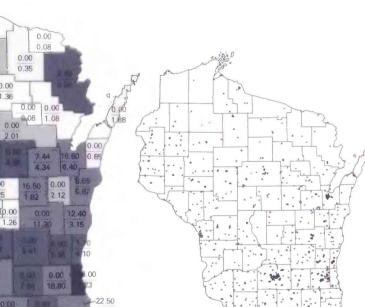
or 65 percent of the State's population.

IRRIGATION About 84 Mgal/d of water was used during 1985. All irrigation reported in the State was spray

Ground water accounts for 98 percent of the water used for irrigation. Consumptive use for irrigation was estimated to be 84 Mgal/d or 100 percent of the total amount Locations of irrigation wells in Wisconsin, 1985

Upper number is surface-water use and

lower number is ground-water use, in



**AGRICULTURAL** 

NON-IRRIGATION

Water used for watering stock, fish hatcheries,

and other on-farm use such as dairy sanitation

About 90 Mgal/d was used for agricultural pur-

The consumptive use for agricultural use was 80

poses; 96 percent of this was ground water.

and cleaning is included in this category.

percent of the total or about 72 Mgal/d.

WATER USE, BY CATEGORY

About 1 percent of water used for thermoelectric power generation was consumed. Most water used for thermoelectric power generation is for once-through cooling and the remainder is returned. the State's electricity. two of these are nuclear.

in Wisconsin, 1985

About 63,600 Mgal/d of water was used by hydroelectric powerplants. Water used for hydroelectric power generation is considered an instream use, in which no water is consumed. Locations of public supply wells

Total Water used for agriculture in Wisconsin, 1985

POWER GENERATION

A total of 5,440 Mgal/d of surface water was

withdrawn for thermoelectric power production.

**EXPLANATION** Hydroelectric power plant Thermoelectric power plant ▼ Nuclear power plant

Thermoelectric plants account for 95 percent of Wisconsin has 22 thermoelectric power plants;

Water use, by catagory, including

